R E M A R K S

Claims 1 to 14 and 17 to 22 as set forth in Appendix I of this paper are now pending in this case. Claim 1 has been amended and Claims 17 to 22 have been added as indicated.

Accordingly, applicants have revised the wording of Claim 1 to reflect that the first polymer material is a non-macroporous material. The respective nature of the first polymer material flows from the information provided on page 2, indicated lines 22 to 28, of the application. The respective section specifically points out that macroporous materials as addressed in the prior art merely take up odorants within their pores whereas the first polymer material employed in the claimed process absorbs the odorant into the polymer matrix or network[1]. New Claim 17 essentially corresponds to Claim 1 with the difference that the swelling of the first polymer material in the odorant is further specified in accordance with the explanations given on page 2, indicated lines 22 to 25, of the application, and the characterization of the first polymer material as "non-macroporous" has been omitted. New Claims 18 to 22 correspond to Claims 7, 8, 11, 13 and 14, respectively, with the difference that the new claims depend either directly or indirectly upon Claim 17. No new matter has been added.

The Examiner rejected Claims 1 to 14 under 35 U.S.C. §103(a) as being unpatentable in light of the teaching of *Pougalan et al.* (US 4,734,278) when taken in view of the disclosure of *Klimesch et al.* (US 5,163,994). In this context, the Examiner points out that *Pougalan et al.* teach polyether-ester-amide type polymers which contain inter alia odorants[2] as co-constituents for the production of plastic articles. The Examiner acknowledges that the resins of *Pougalan et al.* fail to be cross-linked and fail to exhibit a T_g of equal to or less than -10°C[3]. The Examiner contends that the teaching of *Klimesch et al.* shows that particles of cross-linked polymers having a T_g of equal to or less than -10°C are known in the art as a carrier polymers for

---

1) Cf. page 2, indicated lines 4 to 8, of the application, where applicants further emphasize the distinction between adsorption of odorant in pores of polymers and the absorption into the polymer matrix.

2) Cf. col. 1, indicated lines 6 to 26, of *US 4,734,278*.

3) For completeness sake it is respectfully noted that the polymers of *Pougalan et al.* are resinous and -accordingly- not rubber-like.

crop protection agents including pheromones[4], and concludes that it would ave been obvious for a person of ordinary skill in the art to employ the carrier particles addressed by *Klimesch et al.* in the articles referenced by *Pougalan et al.*

However, the carrier particles addressed by *Klimesch et al.* differ from the particulate first polymer material which is defined in applicants' claims. On the one hand, the carrier particles of *Klimesch et al.* are essentially made up from divinylbenzene and a styrene[5]. As such, the cross-linked polymers of *Klimesch et al.*'s carrier particles do not have a T_g of equal to or less than -10°C and cannot be regarded as as exhibiting rubber properties[6]. A person of ordinary skill in the art could therefore not arrive at a process and/or article as defined in applicants' claims merely by replacing the polyether-ester-amide type polymers in the teaching of *Pougalan et al.* by the carrier particles of *Klimesch et al.*

With a particular view to the requirements of Claims 1 to 14 it is further respectfully noted that the carrier beads of *Klimesch et al.* are required to be macroporous[7] whereas the first polymer material employed in accordance with applicants' invention is non-macroporous. The subject matter of applicants' Claims 1 to 14 therefore not only differs from the teaching of *Pougalan et al.* as modified by the Examiner in view of the disclosure of *Klimesch et al.* in that applicants' first polymer material has a Tg which is equal to or less than -10°C but also differs from the teaching of *Pougalan et al.* as modified by the Examiner in view of the disclosure of *Klimesch et al.* in that the first polymer material is non-macroporous.

In light of the foregoing and the attached it is respectfully urged that the subject of applicants' Claims 1 to 14 and 17 to 22 cannot be regarded as being prima facie obvious in light of the teaching of *Pougalan et al.* when taken in view of the disclosure of *Klimesch et al.* favorable reconsideration of the Examiner's position and withdrawal of the respective rejection of applicants' claims under 35 U.S.C. §103(a) is therefore respectfully solicited.

---

4) Cf. in particular Examples 16 to 18, col. 8, indicated line 60, to col. 9, indicated line 23, of *US 5,163,994*.

5) Cf. col. 2, indicated line 64, to col. 3, indicated line 24, of *US 5,163,994*.

6) Polystyrene has a T_g of about 100°C and the T_g generally increases with decreasing flexibility of the polymer chain. Cf. the marked sections in the enclosed copy of *Fried "Polymer Science and Technology"*, Prentice Hall 1995, pages 136, 156 and 157.

7) Cf. col. 2, indicated lines 50 to 53, of *US 5,163,994*.

REQUEST FOR EXTENSION OF TIME:

It is respectfully requested that a *one* month extension of time be granted in this case. A check for the *$110.00* fee is attached.

Please charge any shortage in fees due in connection with the filing of this paper, including Extension of Time fees, to Deposit Account No. 11.0345. Please credit any excess fees to such deposit account.

Respectfully submitted,

KEIL & WEINKAUF

/HBKeil

Herbert B. Keil
Reg. No. 18,967

1350 Connecticut Ave, N.W.
Washington, D.C. 20036
(202) 659-0100

Encl.: THE LISTING OF CLAIMS (Appendix I)
    Fried "Polymer Science and Technology", Prentice Hall 1995, pages 136, 156 and 157

HBK/BAS

Keil & Weinkauf

Polymer Science and Technology

Joel R. Fried
University of Cincinnati

Editorial/production supervision: *Ann Sullivan*
Cover design: *Wanda Lubelska*
Manufacturing manager: *Alexis R. Heydt*

The publisher offers discounts on this book when ordered in bulk quantities. For more information, contact:

Corporate Sales Department
PTR Prentice Hall
113 Sylvan Avenue
Englewood Cliffs, NJ 07632

Phone: 800-382-3419, 201-592-2498
Fax: 201-592-2249
email: dan_rush@prenhall.com

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

ISBN 0-13-685561-X

Prentice-Hall International (UK) Limited, *London*
Prentice-Hall of Australia Pty. Limited, *Sydney*
Prentice-Hall Canada Inc., *Toronto*
Prentice-Hall Hispanoamericana, S.A., *Mexico*
Prentice-Hall of India Private Limited, *New Delhi*
Prentice-Hall of Japan, Inc., *Tokyo*
Simon & Schuster Asia Pte. Ltd., *Singapore*
Editora Prentice-Hall do Brasil, Ltda., *Rio de Janeiro*   **BEST AVAILABLE COPY**

DiMarzio have suggested that there is a temperature, T_2, at which the conformational entropy, S_c (a measure of the total number of ways of arranging a polymer molecule or collection of chains), goes to zero. It can be shown (see Section 5.1.5) that this equilibrium-state temperature lies approximately 52°C below the experimentally-measured T_g, which depends upon the *rate* at which the polymer sample is heated or cooled during measurement. As discussed in Chapter 3, polymeric chains can exist in a large number of possible spatial conformations in solution or in the melt state. Each of these conformations corresponds to a different energy state. As the melt is cooled, fewer high-energy conformations are accessible. If the melt is cooled infinitely slowly to assure the attainment of equilibrium, eventually a temperature will be reached (i.e., T_2) at which only the lowest-energy conformation is available. At this point, the conformational entropy will be zero.

The glass-transition temperature of amorphous polymers can vary widely with the chemical structure of the polymer chain. As illustrated by representative values of T_g for several important polymers given in Table 4.2, T_g can vary over a range of 300°C or more. In general, polymers with flexible backbones and small substituent groups (e.g., polyethylene and polydimethylsiloxane) have low T_g, while those with rigid backbones, such as polymers containing main-chain aromatic groups (e.g., polysulfone), have high T_g. A more detailed discussion of structure–property relationships for the thermal transitions of polymers is given in Section 4.3.3.

TABLE 4.2   REPRESENTATIVE VALUES OF THE GLASS-TRANSITION TEMPERATURE OF SOME AMORPHOUS POLYMERS

Polymer	T_g (°C)
Polydimethylsiloxane	-123
Poly(vinyl acetate)	28
Polystyrene	100
Poly(methyl methacrylate)	105
Polycarbonate	150
Polysulfone	190
Poly(2,6-dimethyl-1,4-phenylene oxide)	220

## 4.1.3   Secondary-Relaxation Processes

As previously discussed, secondary-relaxation processes are small-scale molecular motions that can occur in the amorphous glassy state. These can involve limited motions of the main chain or rotations, vibrations, or flips of substituent
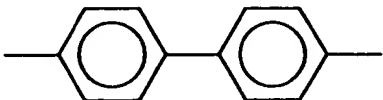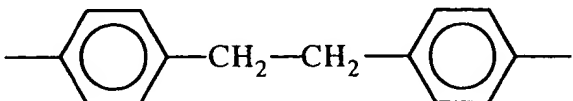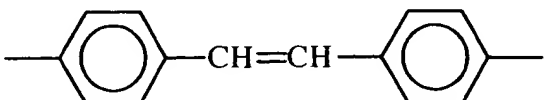
resins. A listing of other important ASTM standards is given in Appendix C at the end of this text.

4.3.3   Structure–Property Relationships

As suggested by data that were given in Tables 4.2 and 4.3, both T_g and T_m are strongly influenced by the chemical structure of the repeating unit. In general, both T_g and T_m increase with decreasing flexibility of the polymer chain. Flexibility decreases with increasing aromatic composition of the main chain or by incorporation of bulky substituent groups or nonrotational (e.g., unsaturated) groups in the main chain. This is illustrated by the relation of T_m to repeating-unit structure for an analogous series of polyesters in Table 4.8. Replacement of the aliphatic sequence $(CH_2)_4$ of compound A with an aromatic ring (compound B) increases T_m by 220°C. Replacement by two coupled aromatic rings (compound C) further increases T_m by 85°C, but incorporation of a flexible $(CH_2)_2$ group between aromatic rings lowers T_m by 135°C (compound D). By contrast, incorporation of a nonrotational, unsaturated –CH=CH– linkage between aromatic rings (compound E) results in the highest-T_m polyester.

TABLE 4.8   EFFECT OF BACKBONE STRUCTURE ON THE CRYSTALLINE-MELTING TEMPERATURE OF POLYESTERS DERIVED FROM ETHYLENE GLYCOL ($HOCH_2CH_2OH$)
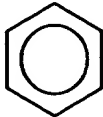
$$\left[\begin{matrix} O & & O \\ \parallel & & \parallel \\ C & -R- & C \end{matrix} -O-CH_2-CH_2-O\right]_n$$
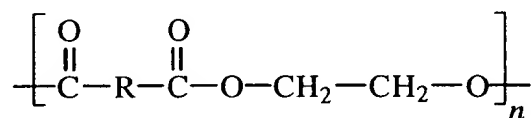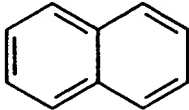
Compound	Main-Chain Unit, R	T_m (°C)
A	$-(CH_2)_4-$	50
B	—⬡—	270
C	—⬡—⬡—	355
D	—⬡—CH_2—CH_2—⬡—	220
E	—⬡—CH=CH—⬡—	420

Chain flexibility is particularly important in determining T_g. Flexible chains, as may be obtained by incorporating an oxygen atom into the main chain (e.g., polydimethylsiloxane), are capable of large-scale molecular motions at very low temperatures and, therefore, have low T_g. Bulky substituent groups hinder chain rotation and therefore raise T_g as shown by structure–T_g comparisons for several vinyl polymers in Table 4.9.

TABLE 4.9 GLASS-TRANSITION TEMPERATURES OF SELECTED VINYL POLYMERS

$$\left[CH_2\!-\!\underset{\underset{R}{|}}{CH} \right]_n$$
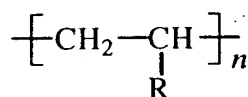
Polymer	Substituent Group, R	T_g (°C)
Polyethylene	H	-125
Polypropylene (atactic)	CH_3	-20
Poly(vinyl chloride)	Cl	89
polyacrylonitrile	C≡N	100
Polystyrene	(phenyl ring)	100
Poly(α-vinyl napthalene)	(naphthalene ring)	135

For comparably sized substituent groups, increasing polarity, which may enhance intermolecular interactions, can elevate T_g. This is illustrated by T_g data for the vinyl polymers — polypropylene ($T_g = -20$°C), poly(vinyl chloride) ($T_g = 89$°C), and polyacrylonitrile ($T_g = 100$°C) — given in Table 4.9. As illustrated in Table 4.10, increasing flexibility of the side group can lower T_g, as is evident by comparison of the chemical structures of poly(methyl methacrylate), poly(ethyl methacrylate), and poly(propyl methacrylate). Syndiotactity increases T_g as illustrated by data for poly(methyl methacrylate) (PMMA) prepared with different tacticities: i-PMMA ($T_g = 45$°C), a-PMMA ($T_g = 105$°C), and s-PMMA ($T_g = 115$°C). *Trans* geometric isomers have higher T_g than *cis*-isomers, as for example in the case of *cis*-polybutadiene ($T_g = -108$°C) compared to *trans*-polybutadiene ($T_g = -18$°C) or